ACC PROJECT 95-079T

# AIR COMBAT COMMAND

## Air Warfare Center

4370 North Washington Blvd, Suite 117
Nellis AFB, Nevada 89191-7076

**OC-135B OPEN SKIES**
**(PHASE II UPGRADE)**

**QOT&E**

**FINAL REPORT**

**MARCH 1997**

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# (PHASE II UPGRADE)

## QOT&E

## FINAL REPORT

**MARCH 1997**


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The purpose of the QOT&E was to evaluate the operational effectiveness and suitability of the modified OC-135B aircraft systems and subsystems to support Open Skies missions. The results of this QOT&E will be used in the fielding decision process and to refine the operational concept.

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## EXECUTIVE SUMMARY

**1. OVERVIEW.** The Air Warfare Center/53d Wing/505th Command and Control Evaluation Group/605th Test Squadron conducted the OC-135B Open Skies (Phase II Upgrade) Qualification Operational Test and Evaluation (QOT&E) in conjunction with an On-Site Inspection Agency (OSIA), Washington, DC, training mission flown from 9 to 16 December 1996. The purpose of the QOT&E was to evaluate the operational effectiveness and suitability of the modified OC-135B aircraft systems and subsystems to support Open Skies missions. The results of this QOT&E will be used in the fielding decision process and to refine the operational concept. All sensors were fully operational except the Synthetic Aperture Radar (SAR); however, the SAR system was activated in order to evaluate the performance of the parts of the system which did work. The four-sortie mission involved numerous and frequent changes in observation parameters, such as aircraft heading, speed, and altitude; combinations of sensors; optical filters; and image recording media. A cold soak of the aircraft for over 24 hours was included to test the auxiliary power unit (APU) capabilities. **Questionnaire responses from crew members and maintenance personnel indicated a high degree of overall satisfaction with the upgrade.** The Phase II upgrade is satisfying user needs; however, operators identified 14 deficiencies and 8 enhancements. The most significant of these was the lack of a Data Annotation, Recording, and Mapping System (DARMS) display at the flight-following station for use by the deputy mission commander (DMC) and flight monitor. The display is considered essential to keeping the workload manageable and in maintaining situation awareness (SA) at the station.

**2. BACKGROUND.** The Under Secretary of Defense for Acquisition directed the Air Force to equip, operate, and maintain aircraft to implement the Treaty on Open Skies, 24 March 1992. In response, three WC-135B aircraft are being modified and redesignated as the OC-135B. Phase I of the modification was completed in 1993 and provided a one-aircraft initial operational capability (IOC). Phase II is an upgrade that provides a two-aircraft full operational capability (FOC). Phase III is a retrofit of the IOC aircraft with FOC. The OC-135B is operated and maintained by the Air Combat Command. Mission crew members consist of both 45th Reconnaissance Squadron, Offutt AFB, Nebraska, and OSIA personnel. The Air Force Operational Test and Evaluation Center completed operational testing of the Phase I system in 1993, and the 418th Flight Test Squadron, Edwards AFB, California, completed flight testing of the Phase II system in November 1996.

**3. DESCRIPTION.** OSIA will use the OC-135B aircraft to deploy worldwide and perform high- and low-altitude observation missions over countries that have ratified the Treaty on Open Skies. The Phase II upgrade includes the addition of an infrared line scanner (IRLS), SAR, video cameras, DARMS, new media storage containers, and a new internal APU. Also included in the upgrade are Inertial Navigation System, Global Positioning System, Combined Altitude Radar Altimeter (CARA), larger optical windows, and various internal equipment modifications to support sensor integration.

**4. RESULTS.**

**a. Overall.** Questionnaire responses from crew members and maintenance personnel indicated a high degree of overall satisfaction with the upgrade. Crew members praised the mission commander (MC) station, DARMS, CARA, APU, and 115-VAC power outlets as noteworthy improvements.

**b. By Objective.**

(1) **Internal APU.** A total of 12 crew members were questioned about APU ground operations. Of these, six were very satisfied, five were satisfied, and one was undecided. A cold soak of over 24 hours with a temperature range from -4 degrees to -24 degrees F was performed. Within 55 minutes of starting the APU at -21 degrees F, the temperature in the crew compartment reached 50 degrees F. The APU provides sufficient cabin heating in extreme cold weather; however, ground heaters were required to heat hydraulic systems before takeoff. This could impact cold weather operations at foreign airfields. Additionally, engine mechanics reported complete maintenance training had not been accomplished.

(2) **Optical Filter Changes.** A total of two sensor maintenance technicians (SMTs) were questioned about the filter change process. Of these, one was satisfied and one was dissatisfied. The main reason cited for dissatisfaction was the speed/contrast switch on the KS-87E Framing Camera could not be adjusted without removing the film magazine.

(3) **CARA Operation by the Pilot, Copilot, Navigator, and DMC.** A total of eight crew members were questioned about CARA operability. Of these, six were very satisfied, one was satisfied, and one was undecided; however, one problem was identified. The pilot's CARA height display constantly indicated an altitude 200 feet lower than the copilot's display.

(4) **Flight-Following Station Displays.** A total of three crew members were questioned about the displays. Of these, two were dissatisfied and one was very dissatisfied. The main reason cited for dissatisfaction was the difficulty in maintaining adequate and timely SA without a DARMS display at the station. Additionally, crew members required a magnetic heading

display to improve SA and a keyboard to allow access to information stored in the DARMS data base. The DARMS and magnetic heading displays and keyboard are needed to reduce the DMC workload and facilitate coordination with onboard representatives of the country being observed.

**(5) Sensor Suite Operation From the Sensor Operator (SO) Station.** A total of four linguist SOs were questioned about sensor suite operability. Of these, one was satisfied and three were dissatisfied. The main reasons cited for dissatisfaction were as follows:

(a) The DARMS inaccurately displayed KS-87 and KA-91C Panoramic Camera status. When the cameras were operating, RDY was displayed rather than ON. This caused operator confusion and is expected to confuse foreign observers on board.

(b) The DARMS indicated mean sea level altitude was in disagreement with the barometric altimeters at all other stations. This error varied from 500 to 700 feet.

(c) The SAR tapes were not formatted and equipment and procedures were not available to accomplish this on the aircraft.

(d) The vertical-looking video camera has a variable focal length which cannot be set to a treaty mandated height/minimum.

(e) The layout of video controls, indications, and workspace was not optimized for completing LSO mission tasks. The video control panel is located to the left of the video monitor and caused physical interference during the mission. The LSO must use the small counter space in front of the video control panel to complete all required logs. In doing this, he can inadvertently bump the controls and alter their settings. Also, the LSO must move his logs to allow access to the video control switches. This can result in the LSO missing entries of important information into the mission logs.

(f) An erroneous default value is programmed into the system for both oblique-mounted KS-87s.

**(6) MC Station Displays.** A total of two MCs were questioned about the displays. Of these, one was satisfied and one was dissatisfied. They also observed the inaccurate DARMS display of KS-87 and KA-91 status and the 500- to 700-foot altitude error.

**(7) Onboard Media Storage Equipment.** A total of two SMTs were questioned about the equipment. Of these, both were satisfied.

**(8) Media Processing.** A time log was kept on media processing activity from receipt of the media at the processing facility to availability of the finished products. Media processing was completed in 7 hours 15 minutes. This met the user requirement.

**(9) Reliability, Maintainability, and Availability (RMA).** A total of two SMTs and four aircraft maintenance technicians were questioned about RMA. The following were identified as the most significant problems:

(a) Training on SAR troubleshooting and repair procedures has not yet occurred.

(b) The Scott high-pressure emergency oxygen bottles cannot be serviced on board the aircraft or outside the US.

(c) Technicians were unable to accurately calibrate the total fuel quantity system.

(d) The KS-87 film magazine cassettes are old and badly worn.

**c. Objectives Not Assessed.**

(1) The capability of the ARC-187 to be operated from the navigator station was not addressed during the QOT&E. Subsequent to approval of the QOT&E plan, OSIA determined the ARC-187 will not be operated on observation missions.

(2) The accessibility of the forward fuel cell was not assessed because repair of the fuel cell was not required.

**5. Conclusion.** The Phase II upgrade of the Open Skies OC-135B is satisfying user needs; however, the identified deficiencies must be corrected to enable the Phase II upgrade to fully support the Open Skies observation mission.

**6. Recommendation.** Expeditiously correct the identified deficiencies and provide the necessary training to technicians responsible for maintaining the SAR and APU.

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## ACRONYMS AND ABBREVIATIONS

ACC..............Air Combat Command
AGL..............above ground level
APU..............auxiliary power unit
ASC..............Aeronautical Systems Center
CARA.............combined altitude radar altimeter
DARMS............data annotation, recording, and mapping system
DMC..............deputy mission commander
DR...............deficiency report
DT&E.............development test and evaluation
EO...............equipment operability
FLTS.............flight test squadron
FLV..............forward-looking video
FM...............flight monitor
FOC..............full operational capability
GPS..............global positioning system
h/min............height/minimum
INS..............inertial navigation system
IOC..............initial operational capability
IPLAN............implementation plan
IRLS.............infrared line scanner
LED..............light emitting diode
LSO..............linguist sensor operator
MC...............mission commander
mm...............millimeter
OCR..............office of collateral responsibility
OPR..............office of primary responsibility
OSIA.............On-Site Inspection Agency
OSMPF............Open Skies Media Processing Facility
QOT&E............qualification operational test and evaluation
QT&E.............qualification test and evaluation
RDU..............remote display unit
RMA..............reliability, maintainability, and availability
RS...............reconnaissance squadron
SA...............situation awareness
SAR..............synthetic aperture radar
SATCOM...........satellite communications
s/c..............speed/contrast
SMT..............sensor maintenance technician
SO...............sensor operator
TMT..............test management team
TS...............test squadron
v/h..............velocity/height
VLDS.............very large data store
VLV..............vertical-looking video
Z................Zulu

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## SECTION 1 - INTRODUCTION

### 1.1 PURPOSE.

**1.1.1** The Air Warfare Center/53d Wing/505th Command and Control Evaluation Group/605th Test Squadron (TS) conducted a Qualification Operational Test and Evaluation (QOT&E) of the OC-135B Open Skies (Phase II Upgrade) in conjunction with a training mission planned and executed by the On-Site Inspection Agency (OSIA), Washington, DC, and the 45th Reconnaissance Squadron (RS), Offutt AFB, Nebraska. The purpose of the QOT&E was to evaluate the operational effectiveness and suitability of the modified OC-135B aircraft systems and subsystems to support Open Skies missions. The results of the QOT&E will be used in the fielding decision process and to refine the operational concept.

**1.1.2** The mission consisted of four sorties flown from 9 to 16 December 1996. It originated at Offutt AFB, spanned nearly 40 hours, and terminated at Wright-Patterson AFB, Ohio, with interim stops at Yokota AB, Japan, Hickam AFB, Hawaii, and Eielson AFB, Alaska.

**1.2 AUTHORITY.** HQ Air Force Program Management Directive 2343(1), C/KC-135 Aircraft Integrated Weapon System Management, 27 January 1994, and HQ ACC Project Order 95-079T, OC-135B Open Skies Qualification Operational Test and Evaluation, 25 September 1995, directed the QOT&E. The project has precedence equal to operational training and director of operations commitments. It is Number 30 on the Air Combat Command (ACC) FY96 OT&E/TD&E Priority List.

### 1.3 BACKGROUND.

**1.3.1** The Under Secretary of Defense for Acquisition directed the Air Force to equip, operate, and maintain aircraft to implement the Treaty on Open Skies, 24 March 1992. In response, the Air Force is modifying three WC-135B aircraft to conform to the treaty. The modification is being accomplished in three phases: Phase I was completed in 1993 and provided a one-aircraft (Number 2674) initial operational capability (IOC), Phase II is an upgrade that provides a two-aircraft (Numbers 2670 and 2672) full operational capability (FOC), and Phase III will be a retrofit of selected elements of the Phase II upgrade to Aircraft 2674. After the retrofit, Aircraft 2674 will be used to support training. The modified aircraft have been redesignated as the OC-135B and are capable of deploying worldwide and performing high- and low-altitude unarmed observation missions over countries that have ratified the Treaty on Open Skies.

**1.3.2** The 418th Flight Test Squadron (FLTS), Edwards AFB, California, conducted a combination development test and evaluation (DT&E) and qualification test and evaluation (QT&E) of the Open Skies Phase II upgrade. Airworthiness testing of the OC-135B with the upgrade has been completed. The DT&E and QT&E ensured the aerial observation capabilities are in accordance with the Treaty on Open Skies. Objectives addressed compliance with treaty technical requirements and functionality of Open Skies systems. A detailed description of the test is contained in Open Skies Test Plan, ASC/AM-94-09-01, 31 August 1995.

**1.3.3** The 605 TS test team was afforded an opportunity to assess the Phase II upgrade prior to completion of DT&E and QT&E. The assessment resulted in deficiencies which were reported in OC-135B Open Skies (Phase II Upgrade) QOT&E Interim Report, August 1996. This final report supersedes the interim report. All deficiencies identified in the final report were experienced during the QOT&E mission and validated results from the earlier sortie. Some deficiencies reported in the interim report were corrected before this dedicated QOT&E mission and are not included in this report.

**1.4 SYSTEM DESCRIPTION.** The OC-135B Open Skies modification involves the sensor suite, AN/APN-232(V) Combined Altitude Radar Altimeter (CARA), voice satellite communications (SATCOM), internal auxiliary power unit (APU), media storage, and additional system changes.

**1.4.1 Sensor Suite.** The sensor suite consists of three KS-87 Framing Cameras; one KA-91 Panoramic Camera; one AN/AAD-5(RC) infrared line scanner (IRLS); one AN/APD-14 Synthetic Aperture Radar (SAR); two video cameras; and a Data Annotation, Recording, and Mapping System (DARMS).

**1.4.1.1 KS-87.** There are three KS-87s mounted in the camera bay compartment; one is mounted vertically and two are mounted obliquely. The oblique cameras are mounted on each side of the aircraft viewing opposite sides of the flight path. The vertical KS-87 has a 3-inch (76-millimeter (mm)) focal length lens as primary and a 6-inch (152-mm) lens as secondary. The oblique KS-87s have a 6-inch focal length lens as primary and a 3-inch lens as secondary. Although the cameras can accept multiple filter types, the treaty allows only Wratten 12 (yellow) and Wratten 25 (red) filters to be used. Operationally, the KS-87s are used for low-altitude flights.

**1.4.1.2 KA-91.** There is one KA-91 mounted vertically in the camera bay compartment. The KA-91 uses an 18-inch focal length lens with a prism that scans across the line of flight. Again, only Wratten 12 and Wratten 25 filters are used. Operationally, the KA-91 is used for high-altitude flights.

**1.4.1.3 IRLS.** The IRLS provides a high-resolution map (in a panoramic format) of the terrain being transversed by the aircraft. The system consists of six components: The control panel, receiver, power supply, recorder, film magazine, and infrared performance analyzer. The control panel is located at the sensor operator (SO) station. The receiver is located just forward of the optical cameras. The remaining units are located on a metal plate aft of the APU.

**1.4.1.4 SAR.** The SAR is an airborne side-looking, day/night, all-weather sensor that consists of a modified AN/UPD-8 Analog Front End and a digital subsystem. The sensor was modified to remove outdated technologies, improve maintainability, and meet treaty requirements. It records the data to tape along with the treaty-required annotation data supplied by the DARMS. The components are connected via an optical data link to a very large data store (VLDS) recorder located in the DARMS rack. The antenna assembly is located on the bottom of the aircraft in a conformal fairing.

**1.4.1.5 Video Cameras.** There are two video cameras--one is vertical looking and the other is forward looking. The vertical-looking video (VLV) camera is mounted in the camera bay and shares the optical window with the KA-91. The forward-looking video (FLV) camera is mounted near the nose of the aircraft, looks forward and down 33 degrees from horizontal, and uses an optical window similar to those in the camera bay. Each camera is equipped with a motorized zoom lens that has a focal length of from 7.3 to 102.0 mm. Information from each camera can be displayed on a 13-inch monitor at the SO station and a 19-inch monitor located across from the mission commander (MC) station. Imagery from the VLV camera can be recorded on a 1/2-inch Super Video Home System magnetic tape. The DARMS provides data annotation information for every frame of VLV as well as header and footer information for each magnetic tape cassette. Imagery from the FLV camera cannot be recorded. The VLV is under consideration for replacement due to treaty certification problems.

**1.4.1.6 DARMS.** The DARMS consists of a data annotation control unit; a computer workstation with keyboard; an uninterruptible power supply; and two high-resolution, 16-inch monitors. The primary function of the DARMS is to provide media annotation in accordance with treaty requirements. In addition, a moving-map display and various parameters, such as date, Universal Time Constant/Coordinated Universal Time, altitude above ground level (AGL), heading, ground speed, latitude, longitude, and time to next waypoint, are displayed throughout a mission. The DARMS provides velocity/height (v/h) calculations to the camera control system for timing the overlap and motion compensation of the images. The v/h ratio is calculated from the velocity received from the Inertial Navigation System (INS) combined with the altitude received from the CARA. The DARMS provides a computer log of various events. It continuously records (at a user-selected rate) navigation and flight data being received from the

INS, Global Positioning System (GPS), CARA, and sensor operation activities. These data are used to produce a mission report once the mission is completed. The DARMS provides the capability for real time monitoring and display of sensor coverage and navigational tracking of the aircraft. The system provides the capability to process navigation and sensor data for display on a moving map, actual navigation path, actual sensor events, planned navigation path, planned sensor events, and other pertinent mission information. The DARMS also provides altitude and INS state-of-health information to the SAR. The INS parameters are used to monitor the quality of the motion measurements. The altitude is used to set the initial reference altitude for the SAR when the SAR is operated.

**1.4.2 CARA**. The CARA indicates aircraft altitude AGL. The control indicator displays absolute altitude from 0 to 50,000 feet. On FOC aircraft, the CARA has two radar altimeter systems. Each system has one RT-1438 receiver-transmitter, one AS-3644 antenna assembly, two control indicators, and one signal data converter. A radar altimeter junction box interconnects the two systems to the pilot and copilot flight direction/rotation go-around systems and to a step relay. Two radar altimeter switches at the flight-following station control the step relay. With the switches, the deputy mission commander (DMC) selects the system that supplies altitude information to the DARMS.

**1.4.3 Voice SATCOM.** Voice SATCOM capability is provided by the AN/ARC-187 Ultrahigh Frequency Radio Set. The control head is located at the navigator station.

**1.4.4 Internal APU.** The APU is located on the left side of the cargo floor just forward of the camera bay compartment. The APU is for ground use only and provides engine start, cabin heat, and electrical power during ground operations. The electrical power is used to operate all aircraft and Open Skies systems without the aid of external support equipment.

**1.4.5 Media Storage.** Seven portable coolers are used to satisfy onboard media storage requirements. Each cooler can hold up to eight film canisters and four cassettes. Temperature requirements are being met by using the refrigeration units included in the coolers. When required, warming media to operating temperature is done with commercial off-the-shelf thermal blankets in an electrically heated, insulated box. The box can hold up to 10 rolls of film and 3 cassettes.

**1.4.6 Additional System Changes**. The Phase II upgrade also includes INS, GPS, larger optical windows, and various internal equipment modifications to support sensor integration.

**1.5 OPERATIONAL CONCEPT.** The operational concept for the OC-135B is summarized in the HQ ACC Open Skies Implementation Plan (IPLAN), 1 February 1995. The IPLAN was developed from the Treaty on Open Skies.

**1.5.1 Threat.** Open Skies missions are flown with the permission of the country being observed. The overall objective of the treaty is to promote openness between signatories. Therefore, a threat intended to counter or disable this system is not anticipated.

**1.5.2 Employment.** The Open Skies observation mission begins no earlier than 24 hours after the arrival of the OC-135B at an Open Skies airfield. The mission is flown anywhere within the country being observed along an approved flight path. A mission profile consists of numerous cruise and descent to observation area (and repeat) segments with an overall range dependent upon the nation being overflown. Imaging with the optical camera, IRLS, SAR, and video sensors is done according to an approved mission plan. Exposed film is placed in individual containers, sealed as soon as practical after being removed from the camera magazine, and annotated according to the Treaty on Open Skies. The exposed film is processed in the Open Skies Media Processing Facility (OSMPF), Wright-Patterson AFB.

**1.5.3 Support.** The OC-135B is intended to be capable of operating independent of unique support equipment for periods of up to 2 weeks. Logistics support during an Open Skies mission primarily consists of organizational-level maintenance provided by two dedicated crew chiefs and six additional maintenance personnel on board the aircraft. Required depot-level maintenance and modifications are coordinated through 12th Air Force and HQ ACC functional managers and performed by Air Force Materiel Command or contract maintenance, as appropriate. Limited off-equipment repair for the KS-87 and KA-91 is performed at Offutt AFB. Similar support is planned for the IRLS, SAR, and video cameras.

**1.6 SCOPE.** The training mission was planned by OSIA to be operationally representative of a demanding Open Skies mission. The OSIA mission plan required extensive use of onboard systems; however, a SAR system failure and associated troubleshooting created a heavier than usual crew workload. Observation media collected during the mission were processed in the OSMPF.

**1.6.1 Planning Considerations.**

**1.6.1.1** OSIA planned the mission in order to meet training requirements and QOT&E objectives. Due to treaty restrictions, the first two sorties to Yokota AB and from Yokota AB to Hickam AFB had to be flown with the sensor windows covered. During these two sorties, all systems were operated without recording media. The DARMS was closely observed during the transition across the international date line. The next two sorties from Hickam AFB to Eielson AFB and from Eielson AFB to Wright-Patterson AFB were dedicated to the QOT&E and all operational systems were used. In addition, a cold soak at Eielson AFB was used to assess the internal APU.

**1.6.1.2** The most realistic and cost-effective method of completing the QOT&E was through data collection during an operationally representative training sortie. In this way, training goals and assessment objectives were addressed simultaneously using the same resources.

**1.6.2 Objectives.** The QOT&E was intended to address the following objectives.

a. Objective 1. Assess the capability of the internal APU to support OC-135B ground operations without the aid of external support equipment.

b. Objective 2. Assess the capability of the KS-87 and KA-91 to accommodate optical filter changes.

c. Objective 3. Assess the capability of the CARA to be operated by the pilot, copilot, navigator, and DMC.

d. Objective 4. Assess the capability of displays available at the flight-following station to present flight information to the DMC and flight monitor (FM).

e. Objective 5. Assess the capability of the sensor suite to be operated from the SO station.

f. Objective 6. Assess the capability of displays available at the MC station to present mission information to the MC and other observers.

g. Objective 7. Assess the capability of the ARC-187 to be operated from the navigator station.

> **NOTE:** The capability of the ARC-187 to be operated from the navigator station was not addressed during the QOT&E. Subsequent to approval of the QOT&E plan, OSIA determined the ARC-187 will not be operated on missions.

h. Objective 8. Assess the capability of onboard storage and temperature-conditioning equipment to maintain and prepare recording media for use.

i. Objective 9. Assess the timeliness of recorded media processing.

j. Objective 10. Assess the reliability, maintainability, and availability (RMA) of the sensor suite equipment and internal APU.

k. Objective 11. Assess the accessibility of the forward fuel cell.

> **NOTE:** The accessibility of the forward fuel cell was not assessed because repair of the fuel cell was not required.

**1.6.3 Limiting Factors.**

**1.6.3.1** The SAR antenna developed a problem which prohibited radar transmission; however, the SAR system was activated in order to evaluate the performance of the parts of the system that did work.

**1.6.3.2** Although the IRLS and VLV camera were used during the mission, they are not treaty certified at this time due to unresolved problems with image quality.

**1.6.3.3** The QOT&E provided insufficient equipment operating time to support calculation of meaningful numeric RMA values.

**1.6.3.4** Although operator proficiency appeared high during the training mission, some operators had not completed specific training on some equipment items.

**1.7 KEY PERSONNEL.** Table 1-1 provides a list of personnel who had responsibilities essential to planning, supporting, conducting, and reporting this QOT&E.

## Table 1-1. Key Personnel.

| Title | Name | Organization | DSN |
|---|---|---|---|
| Project Officer | Maj Pillet | HQ ACC/DRRR | 574-7434 |
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**LEGEND:**
ASC is Aeronautical Systems Center.
DR is deficiency report.
DSN is Defense Switched Network.
TMT is test management team.

* TMT members.

## SECTION 2 - RESULTS

**2.1 GENERAL PROCEDURE.** OSIA planned the QOT&E mission to be workload intensive. Their intent was to positively stress the system and operators through an extended duration sortie with multiple flight and sensor parameter changes. Flight crew members and sensor maintenance technicians (SMTs) were from the 45 RS. Mission crew members were from OSIA.

**2.1.1** The OC-135B took off from Offutt AFB at 1830 Zulu (Z) on 9 December 1996. The sensor covers were installed to meet treaty requirements flying into Japan. All aircraft systems and all Phase II upgrade systems were operated with the exception of actually recording media from the sensors and radiating the SAR. The sortie progressed over Canada toward Alaska. Air refueling was accomplished south of Alaska. At 0558Z, preparation was made to operate the KS-87s and KA-91 to record DARMS data to film while crossing the International Date Line. DARMS and INS displays were observed during the transition from 179°59'W to 179°59'E and the system made the transition flawlessly. No other sensor events occurred. The mission continued from Yokota AB on 11 December 1996 with a takeoff at 2209Z. Once again, all equipment was operated, but the covers were installed. The sortie was a direct flight to Hickam AFB with a landing at 0510Z. The dedicated QOT&E sorties began from Hickam AFB at 1921Z, 14 December 1996. The first sensor runs were accomplished on several passes over the Hawaiian Islands. All sensors were used except the SAR which experienced a failure. The sortie progressed toward Eielson AFB. The original mission plan was SAR intensive and the flight path had to be adjusted to allow for optical sensor runs ingressing the Alaskan coast line. Aircraft landing and the beginning of the cold soak was at 0521Z, 15 December 1996. Takeoff from Eielson AFB for the final sortie was at 1853Z, 16 December 1996. The mission progressed to an entry point at Seattle, Washington, to image multiple cultural and military targets on the way to Wright-Patterson AFB. Due to a delayed takeoff from Alaska, available light was diminished by the time Mountain Home AFB, Idaho, was imaged. Usable optical sensor data were not obtained during the final 2 hours of the sortie. Landing at Wright-Patterson AFB occurred at 0408Z, 17 December 1996.

**2.1.2** Each sensor except the SAR was used during the sortie. The three KS-87s imaged multiple cultural and military targets at altitudes ranging from 3,000 to 7,000 feet AGL. Multiple filter, film type, and magazine changes were made during the mission. The KS-87s exposed 3,900 feet of film. The KA-91 imaged multiple cultural and military targets at altitudes ranging from 12,000 to 20,000 feet AGL. Several magazine changes were made during the sortie. The KA-91 exposed 1,800 feet of film. The IRLS imaged multiple cultural and military targets at altitudes throughout the flight envelope. The IRLS exposed 500 feet of film.

**2.1.3** To maximize training, OSIA and 45 RS rotated personnel on each duty position. This also benefitted the assessment by providing more than one questionnaire respondent for each duty position.

**2.1.3.1** Each linguist SO (LSO) completed an extensive set of tasks which included updating inputs to the DARMS, informing the DMCs of sensor on and off time, logging all sensor events, and updating weather information for each sensor pass. A significant amount of time was spent in multiple attempts to operate the SAR.

**2.1.3.2** Each SMT also completed an extensive set of duties which included multiple filter changes between sensor runs, adjusting the speed/contrast (s/c) switch for each filter change, reloading film cassettes and magazines, logging film use, and storing exposed film.

**2.1.3.3** Each DMC's workload was heavy. Flight monitoring included the tasks of following the aircraft flight path and altitude, identifying obstructions, directing actions to execute the mission plan, and coordinating course and other navigational changes resulting from air traffic control direction and weather.

**2.1.3.4** Each MC oversaw the entire observation effort. This included monitoring flight and sensor activity, directing all mission-related tasks, and ensuring crew coordination.

**2.1.4** The TMT collected data throughout the mission by observing crew activity and equipment performance and administering questionnaires. TMT members used logbooks and photographic and video equipment to record their observations. Each crew member completed a questionnaire on each duty position he occupied during the mission. In addition, the TMT collected copies of pertinent flight logs at the end of the sortie and recorded information revealed at the debriefing sessions. TMT members then validated and consolidated the data from the various sources to form a data base for analysis and assessment.

**2.1.5** TMT members analyzed and assessed the Open Skies Phase II upgrade with respect to the stated objectives. In addition, TMT members prepared and submitted DRs to Oklahoma City Air Logistics Center/LCRE, Tinker AFB, Oklahoma, for resolution and action.

## 2.2 RESULTS BY OBJECTIVE.

**2.2.1 Objective 1.** Assess the capability of the internal APU to support OC-135B ground operations without the aid of external support equipment.

**2.2.1.1 Measure.** Flight, mission, and maintenance crew member judgment of the sufficiency of engine starting, cabin heating, and electrical power during ground operations without the aid of external support equipment.

**2.2.1.2 Procedure.** The APU was used to provide cabin heat and engine start during ground operations in preparation for all four sorties. A cold soak of over 24 hours at a temperature range of -4 degrees to -24 degrees F was accomplished. A TMT member observed the activity and administered a questionnaire to each participating crew member.

**2.2.1.3 Findings.** A total of 12 crew members participated in ground operations and completed the questionnaire. Of these, six were very satisfied, five were satisfied, and one was undecided. After the cold soak, the APU was started at 1130Z, 16 December 1996. The cabin temperature was -21 degrees F. After 55 minutes of operation, the ambient temperature in the crew compartment had risen to 50 degrees F. It is notable that this temperature increase was accomplished without operating the APU at the maximum pressure setting. The following two enhancements were recommended by crew members.

**2.2.1.3.1 Enhancement: Excessive Airflow Noise at High Heat Settings (DR FA4521960021).** When the APU was used to provide cabin heat, the high heat settings produced a very irritating roar in the aircraft heating air ducts. Although required communications were conducted with the roar present, completion of mission tasks would be more convenient and crew comfort would be improved if the roar was eliminated or attenuated.

**2.2.1.3.2 Enhancement: APU Battery Access (DR FA4521970005).** The access cover for the internal APU battery is located under the SMT film loading table. The quick-release fasteners installed for ease of removal have a slotted screw head. The extra film cassette storage adjacent to the battery cover made it difficult to remove the fasteners.

**2.2.1.4 Other Findings.**

**2.2.1.4.1** The APU provides sufficient cabin heating in extreme cold weather; however, ground heaters were required to heat hydraulic systems before takeoff. This could impact cold weather operations at foreign airfields.

**2.2.1.4.2** Engine mechanics reported complete maintenance training had not been accomplished at this time.

**2.2.1.5 Conclusion.** The capability of the internal APU to provide cabin heating, electrical power, and engine starting without the aid of external support equipment fully supports the OC-135B ground operations.

**2.2.1.6 Recommendations.**

**2.2.1.6.1** Provide the enhancements identified by DRs FA4521960021 and FA4521970005 (Office of Primary Responsibility (OPR): HQ ACC/DRRR; Office of Collateral Responsibility (OCR): HQ ACC/DOYR).

**2.2.1.6.2** Provide necessary training to technicians responsible for maintaining the APU (OPR: HQ ACC/LGM).

**2.2.2 Objective 2.** Assess the capability of the KS-87 and KA-91 to accommodate optical filter changes.

**2.2.2.1 Measure.** SMT judgment of optical filter changeability in preparation for and during missions.

**2.2.2.2 Procedure.** The filters were changed on alternating KS-87 and KA-91 runs throughout the mission. The Wratten 25 filter was used for one "sensors on" period then changed to Wratten 12 for the next "sensors on" period. A TMT member observed the filter changes and administered a questionnaire to each SMT.

**2.2.2.3 Findings.** A total of two SMTs changed the filters and completed the questionnaire. Of these, one was satisfied and one was dissatisfied. The reason for dissatisfaction was identified as a mission-degrading deficiency. This deficiency and an identified area of special satisfaction follow.

**2.2.2.3.1 Deficiency: S/C Switch on KS-87Es Difficult to Access (DR FA4521960009).** Each KS-87 filter change required resetting the s/c switch which revealed a problem with the s/c switch location. To reset the s/c switch, the film magazine had to be removed. The s/c switch is also near the focal plane shutter which, in the unstable environment of flight, could easily be destroyed by a slip of the screwdriver being used to do the reset. The time required to remove and replace the magazine and the potential for damage to the focal plane shutter degrade mission accomplishment.

**2.2.2.3.2 Area of Special Satisfaction.** The overall consensus of the SMTs was that the modified KS-87 filter holders worked very well. They allowed the actual filter changes to be made quite easily.

**2.2.2.4 Conclusion.** The KS-87 and the KA-91 accommodate optical filter changes; however, the KS-87 must be improved to fully accommodate resetting the s/c switch.

**2.2.2.5 Recommendation.** Correct the mission-degrading deficiency identified by DR FA4521960009 (OPR: HQ ACC/DRFR; OCR: HQ ACC/DOYR).

**2.2.3 Objective 3.** Assess the capability of the CARA to be operated by the pilot, copilot, navigator, and DMC.

**2.2.3.1 Measure.** Pilot, copilot, navigator, and DMC judgment of CARA equipment operability (EO). EO is the capability of equipment (including subsystems and components) to be controlled by the operator in conducting the assigned mission tasks.

**2.2.3.2 Procedure.** The CARA was operated throughout the mission by the appropriate crew members. A TMT member observed the operation and administered a questionnaire to each of these crew members.

**2.2.3.3 Findings.** A total of eight crew members operated the CARA and completed the questionnaire. Of these, six were very satisfied and one was satisfied with the capability and one was undecided. However, one problem was noted and identified as a mission-degrading deficiency. This deficiency, an enhancement, and an identified area of special satisfaction follow.

**2.2.3.3.1. Deficiency: CARA Altitude Error (DR FA4521960007).** The aircraft altitude was changed frequently during the mission. Crew members noticed the altitude displayed on the pilot CARA height display was consistently 200 feet lower than the altitude indicated on the copilot display throughout the altitude range of the mission.

**2.2.3.3.2 Enhancement: Navigator CARA Display Position (DR FA4521970007).** The CARA display at the navigator station is located on the left side of the panel and all other altimeter displays are located on the right. Although the navigators can complete all mission tasks under the current conditions, their instrument cross-check would be improved if similar displays were located together.

**2.2.3.3.3 Area of Special Satisfaction.** The overall consensus of the crew members was that the CARA is a good replacement for the radio altimeter and the light emitting diode (LED) readout was excellent for landing approach work.

**2.2.3.4 Conclusion.** The capability of the CARA to be operated by the pilot, copilot, navigator, and DMC supports completion of their mission tasks; however, the altitude error must be corrected.

**2.2.3.5 Recommendations.**

**2.2.3.5.1** Correct the mission-degrading deficiency identified by DR FA4521960007.

**2.2.3.5.2** Provide the enhancement identified by DR FA4521970007 (OPR: HQ ACC/DRFR; OCR: HQ ACC/DOYR).

**2.2.4 Objective 4.** Assess the capability of displays available at the flight-following station to present flight information to the DMC and FM.

**2.2.4.1 Measure.** DMC and FM judgment of the capability of the displays to present the required information in a usable form and to be viewed from the flight-following station seat.

**2.2.4.2 Procedure.** The flight-following station was manned and operated throughout the mission by the appropriate crew members. They tracked mission plan progress and recorded deviations. Deviations to the flight plan were required to change from a SAR profile to optical profile. A TMT member observed the activity and administered a questionnaire to each crew member who manned the station.

**2.2.4.3 Findings.** A total of three crew members manned the station and completed the questionnaire. Of these, two were dissatisfied and one was very dissatisfied with the capability. The reasons for dissatisfaction were three problem areas identified as mission-degrading deficiencies. These deficiencies, one enhancement, and an identified area of special satisfaction follow.

**2.2.4.3.1 Deficiency: Flight-Following Station Does Not Have a DARMS Display (DR FA4521960001).** As the sortie workload at the station accumulated, it became increasingly difficult for the DMC and the FM to keep up with their mission tasks and maintain situation awareness (SA) without a visual display. In order to adequately follow the intended flight path, maintain the proper corridor, observe exactly which sensors were operating and their configuration, observe actual present position, and be prepared to answer any questions raised by observed party members, the DMC and FM needed a DARMS display at their station. During the mission, they were frequently forced to turn 180 degrees to view the DARMS display at the SO station located across the aisle and directly behind them.

**2.2.4.3.2 Deficiency: Flight-Following Station Does Not Have a Magnetic Heading Indicator (DR FA4521960002).** A magnetic heading display is required at the flight-following station to improve SA. The only heading currently displayed is true heading and, when magnetic heading was needed, these data had to be manually converted.

**2.2.4.3.3 Deficiency: Flight-Following Station Does Not Have DARMS Data Access (DR FA4521960003).** The need for keyboard access to the DARMS at the flight-following station became evident before and during the mission because of the intensive workload produced by the mission plan. Navigation data, digital aeronautical flight information, and other related data bases are available in the DARMS but can be accessed only from the SO station. When the DMC needed the information, he had to ask the LSO to call it up. The LSO can provide this assistance but only on a noninterference basis with his own duties.

**2.2.4.3.4 Enhancement: Flight Following Station Needs a True Airspeed Indicator (DR FA4521970006).** Throughout the QOT&E mission, the DMC had to ask other crew members for the aircraft true airspeed in order to complete his logs. This increases the DMC workload, interphone chatter, and confusion for foreign observers. Although the DMC tasks can be completed under the current configuration, their operation would be more effective if this enhancement was added.

**2.2.4.3.5 Area of Special Satisfaction.** Operators commended the addition of 115-VAC outlets and said the INS Remote Display Unit (RDU) was a real plus. They especially thought the RDU, Page 8, "frozen position" was a nice feature and the navigation radar was identified as "excellent."

**2.2.4.4 Conclusion.** The capability of displays available at the flight-following station must be improved to fully support completion of DMC and FM mission tasks.

**2.2.4.5 Recommendations.**

**2.2.4.5.1** Correct the mission-degrading deficiencies identified by DRs FA4521960001, FA4521960002, and FA4521960003.

**2.2.4.5.2** Provide the enhancement identified by DR FA4521970006 (OPR: HQ ACC/DRFR; OCR: HQ ACC/DOYR).

**2.2.5 Objective 5.** Assess the capability of the sensor suite to be operated from the SO station.

**2.2.5.1 Measure.** LSO judgment of EO for each item in the sensor suite.

> **NOTE:** The SAR was inoperative for this mission; however, some parts of the system and operating procedures were assessed.

**2.2.5.2 Procedure.** Each item in the sensor suite was operated from the SO station during the mission. A TMT member observed the operation and administered a questionnaire to each LSO.

**2.2.5.3 Findings.** A total of four LSOs operated the sensor suite and completed the questionnaire. Of these, one was satisfied and three were dissatisfied. The reasons for dissatisfaction were six problem areas identified as mission-degrading deficiencies. These deficiencies, three enhancements, and an identified area of special satisfaction follow.

**2.2.5.3.1 Deficiency: DARMS Does Not Display Correct Status of Cameras (DR FA4521960004).** When the KS-87s or KA-91 were actually taking pictures, the indication on the DARMS was RDY rather than ON. This caused operator confusion and is expected to confuse foreign observers on board.

**2.2.5.3.2 Deficiency: DARMS Altitude Disparity (DR FA4521970001).** Throughout the mission, the DARMS mean sea level altitude reading was in disagreement with the barometric altimeters at all other stations. This error varied from 500 to 700 feet. This erroneous indication will cause the media annotation to be in error and could cause foreign observers to question the actual altitude being used for h/min calculation.

**2.2.5.3.3 Deficiency: SAR Tape Formatting (DR FA4521970004).** Each time a new, reportedly formatted tape was inserted into the Metrum VLDS recorder, it would automatically eject. No written procedures or equipment were available on the aircraft to format the tapes, and no preformatted tapes were available.

**2.2.5.3.4 Deficiency: VLV Focal Length Not Fixed (DR FA4521960008).** The VLV camera has a variable focal length. This prevents establishment of a treaty mandated height/minimum (h/min).

**2.2.5.3.5 Deficiency: Video Control Panel Location Interferes With Mission Tasks (DR FA4521960011).** The layout of video controls, indications, and workspace was not optimized for completing LSO mission tasks. The video control panel is located to the left of the video monitor and caused physical interference during the mission. The LSO must use the small counter space in front of the video control panel to complete all required logs. In doing this, he can inadvertently bump the controls and alter their settings. Also, the LSO must move his logs to allow access to the video control switches. This could result in the LSO missing entries of important information into the mission logs.

**2.2.5.3.6 Deficiency: Default Focal Length Error for Oblique KS-87Es (DR FA4521960013).** An erroneous default value is programmed into the DARMS for both oblique-mounted KS-87s. When the camera control panel was turned off to correct a malfunction, the DARMS defaulted to a 76-mm lens setting instead of the correct 152-mm value. The wrong default value was not evident until the next "sensors on" event. At that time, the sensor footprint displayed on the DARMS moving map display was significantly larger than the area actually being imaged. This required extra time to correct, put erroneous data in the DARMS mission data log, and could be alarming to foreign observers on board.

**2.2.5.3.7 Enhancement: DARMS Does Not Have Hot Key Access to Sensor Configuration Window (DR FA4521960019).** The DARMS provides hot key access to various control functions. This is very helpful to the operator and reduces the time necessary to update system information. The sensor configuration window is updated for every change in sensor, film, filter, and magazine. This window should have hot key access to reduce the impact currently experienced after configuration changes. The method of using mouse inputs is too time-consuming. Although the task was completed during the mission using the current method, the process would be more efficient if a hot key capability was added.

**2.2.5.3.8 Enhancement: DARMS Magazine Inventory Difficult to Update (DR FA4521960020).** When film magazines are replenished and changed, the serial numbers of the new magazine and cassettes must be entered into the DARMS data base. If a new magazine is currently in the DARMS inventory, the data entry is done in the sensor configuration window. If the magazine had not been used previously on the aircraft, it must be entered into the inventory. The new magazine serial number cannot be entered from the sensor configuration window. A separate menu window must be used and this extra data entry sequence causes delays in getting the proper serial numbers into the data base. Although the task was completed while using the current sequence, the process would be more efficient if it could be done in fewer steps.

**2.2.5.3.9 Enhancement: DARMS Keyboard (DR FA4521970008).** Each time the LSO stowed or removed the keyboard from the stowed position to make entries, the locking devices had to be latched and unlatched. The keyboard was stowed allowing more counter space to fill out all required logs and removed only to make data entries into the system. Although the task was completed during the mission using the current equipment, the process would be more convenient if the keyboard was on slides or rails.

**2.2.5.3.10 Area of Special Satisfaction.** The overall consensus of the crew members was that the DARMS is a vast improvement over the IOC aircraft annotation system (Miletus) and provided heightened SA.

**2.2.5.4 Conclusion.** The capability of the sensor suite to be operated from the SO station must be improved to fully support completion of LSO mission tasks.

**2.2.5.5 Recommendations.**

**2.2.5.5.1** Correct the mission-degrading deficiencies identified by DRs FA4521960004, FA4521960008, FA4521960011, FA4521960013, FA4521970001, and FA4521970004.

**2.2.5.5.2** Provide the enhancements identified by DRs FA4521960019, FA4521960020, and FA4521970008 (OPR: HQ ACC/DRFR; OCR: HQ ACC/ DOYR).

**2.2.6 Objective 6.** Assess the capability of displays available at the MC station to present mission information to the MC and other observers.

**2.2.6.1 Measure.** MC and other observer judgment of the capability of the displays to present the required information in a usable form and to be viewed from the MC seat and observer seats near the MC station.

**2.2.6.2 Procedure.** The MC station was manned and operated throughout the mission. The MC tracked mission plan progress, monitored mission parameters, and executed overall mission control from this position. A TMT member observed the activity and administered a questionnaire to each MC who manned the station.

**2.2.6.3 Findings.** A total of two MCs manned the station and completed the questionnaire. Of these, one was satisfied and one was dissatisfied. Operators commented that the DARMS and video monitors at the MC station were outstanding and facilitated excellent mission following. However, they noted two problems also observed by the LSOs. The DARMS did not display the true status of the KS-87s and KA-91 when they were operating and the 500- to 700-foot altitude error on the DARMS. As previously mentioned, this could confuse foreign observers on board (DR FA4521960004 and DR FA4521970001).

**2.2.6.4 Conclusion.** The capability of displays available at the MC station supports completion of MC and other observer mission tasks; however, inaccurate presentation of KS-87 and KA-91 operating status and the DARMS altitude error must be corrected.

**2.2.6.5 Recommendation.** Correct the mission-degrading deficiencies identified by DR FA4521960004 and DR FA4521970001 (OPR: HQ ACC/DRFR; OCR: HQ ACC/DOYR).

**2.2.7 Objective 8.** Assess the capability of onboard storage and temperature-conditioning equipment to maintain and prepare recording media for use.

**2.2.7.1 Measure.** SMT judgment of the capability of the media storage and temperature-conditioning equipment to support mission tasks.

**2.2.7.2 Procedure.** The media storage coolers were used before takeoff and throughout the mission. The temperature-conditioning equipment was also used on the Alaskan leg of the mission. A TMT member observed use of the coolers and administered a questionnaire to each SMT.

**2.2.7.3 Findings.**

**2.2.7.3.1** A total of two SMTs used the coolers and completed the questionnaire. Of these, both were satisfied with the capability. However, one area was identified as an enhancement.

**2.2.7.3.2 Enhancement: Media Storage Rail Locking Pins Difficult to Insert (DR FA4521960018).** When the media storage coolers are pulled from the stowed position, a push-to-release pin must be installed to keep the cooler from rolling back into the stowed position. The same pins are also used to keep the cooler in the stowed position. SMTs had difficulty during the mission because the pin holes did not align properly. Alignment of the pin holes had to be forced in order to insert the pins. Although SMT tasks were completed under the current conditions, cooler operation would be more convenient if insertion of the pins was made easier.

**2.2.7.4 Conclusion.** The capability of the onboard media storage and temperature-conditioning equipment fully supports the OC-135B mission.

**2.2.7.5 Recommendation.** Provide the enhancement identified by DR FA4521960018 (OPR: HQ ACC/DRFR; OCR: HQ ACC/DOYR).

**2.2.8 Objective 9.** Evaluate the timeliness of recorded media processing.

**2.2.8.1 Measure and Criterion.** The measure is the time required to process recorded media. The treaty criterion is that film-based media must be processed (to include creation of one copy) within 72 hours of arrival at the point of exit. There is no criterion for processing magnetic media.

**2.2.8.2 Procedure.** For the mission, the point of exit was designated as Wright-Patterson AFB. An OSMPF representative kept a time log on activity from delivery of exposed media to the OSMPF until all media were processed. The log was collected by a TMT member. The TMT member also observed a portion of the processing activity and examined several samples of the finished product.

**2.2.8.3 Findings.** The OSMPF processed the film-based media within the required time limits. Over 6,200 feet of film were processed in 7 hours 15 minutes. Based on experience, a duplicate copy of this amount of film would take an additional 6 to 8 hours, well within treaty limits. Additionally, the process was observed to be smooth and efficient, and no imagery degradations attributable to processing were found.

**2.2.8.4 Conclusion.** Media processing by the OSMPF meets user requirements.

**2.2.8.5 Recommendation.** None.

**2.2.9 Objective 10.** Assess the RMA of the sensor suite equipment and internal APU.

**2.2.9.1 Measure.** SMT and aircraft maintenance technician judgment of RMA characteristics of each new or modified item.

**2.2.9.2 Procedure.** Each new or modified item in the sensor suite except the SAR was prepared for and/or operated during the mission. A TMT member observed the activity and administered a questionnaire to each participating SMT and aircraft maintenance technician. The TMT made no attempt to calculate numeric values for RMA because of the small amount of operating time accumulated.

**2.2.9.3 Findings.**

**2.2.9.3.1** A total of two SMTs and four aircraft maintenance technicians participated and completed the questionnaire. They reported that training on the troubleshooting and repair of the SAR and the internal APU has not yet occurred. Also, the VLV failed during the last sortie. DR FA4251960008, VLV Focal Length Not Fixed, was submitted as a result of the interim test; therefore, the VLV system is in the process of being redesigned to use a fixed lens in place of a variable lens. They also identified the deficiencies described below.

**2.2.9.3.2 Deficiency: Excessive Wear on KS-87E Film Magazine Cassettes (DR FA 4521960012).** The film cassettes used in the KS-87E film magazines were very old and showed signs of excessive wear. The worn cassettes used in the magazines allowed slack in the film advance mechanism. During aircraft preflight, this slack caused a sensor failure indication at the LSO station.

**2.2.9.4 Conclusion.** The RMA of sensor suite equipment and the internal APU must be improved to fully support Open Skies observation mission requirements.

**2.2.9.5 Recommendations.**

**2.2.9.5.1** Correct the mission-degrading deficiency identified by DR FA4521960012 (OPR: HQ ACC/DRFR; OCR: HQ ACC/DOYR).

**2.2.9.5.2** Provide necessary training to technicians responsible for maintaining the SAR and internal APU.

### 2.2.10 Additional Findings.

#### 2.2.10.1 Deficiencies.

**2.2.10.1.1 Fuel Quantity Calibration Problems (DR FA4521970002).** Maintenance personnel reported the removal of the fuel cell (for the SAR installation) has caused fuel quantity calibration problems. Each time the total fuel quantity is calibrated, they get from 200 to 2,500 pounds difference. The problem is caused by the removal of one fuel probe and cell in the system. Numerous refuel/defuel calibrations have been performed with no consistent results. This problem is currently being worked by engineers at ASC, Wright-Patterson AFB.

**2.2.10.1.2 Scott Oxygen Bottle Service (DR FA4521970003).** High-pressure emergency oxygen bottles expended during flights require servicing prior to the next flight. There is currently no way to service these bottles on the aircraft; therefore, they must be sent to a contractor in the US.

**2.2.10.2 Conclusion.** The RMA of sensor suite and other aircraft equipment must be improved to fully support Open Skies observation mission requirements.

**2.2.10.3 Recommendation.** Correct the mission-degrading deficiencies identified by DRs FA4521970002 and FA4521970003 (OPR: HQ ACC/DRFR; OCR: HQ ACC/DOYR).

### 2.3 PRIORITIZED DRs.

**2.3.1 Prioritization.** The TMT prioritized the DRs after discussion of each item with crew members. The basic guideline used in prioritization was the beneficial effect correction would have on mission accomplishment. Table 2-1 lists the DRs by priority for resolution.

**2.3.2 Impact Summary.** If uncorrected, the deficiencies listed in Table 2-1 will impact the capability of the OC-135B to fully support the Open Skies mission. Individually and in aggregate, they will degrade mission performance in a variety of ways including contributing to crew member workload saturation, loss of SA, misunderstandings by foreign observers, and suboptimization of collected observation data. The enhancements listed in Table 2-1 will have little or no impact on the mission if not implemented. Crew members can work around the inconveniences to complete mission tasks but at the expense of using extra time and energy.

**Table 2-1. Prioritized DR List.**

| Priority | Number | Title |
|---|---|---|
| Deficiency | | |
| 1 | FA4521960001 | Flight-Following Station Does Not Have a DARMS Display |
| 2 | FA4521960002 | Flight-Following Station Does Not Have a Magnetic Heading Indicator |
| 3 | FA4521960003 | Flight-Following Station Does Not Have DARMS Data Access |
| 4 | FA4521960004 | DARMS Does Not Display Correct Status of Cameras |
| 5 | FA4521970001 | DARMS Altitude Disparity |
| 6 | FA4521970002 | Fuel Quantity Calibration Problems |
| 7 | FA4521970003 | Scott Oxygen Bottle Service |
| 8 | FA4521960007 | CARA Altitude Error |
| 9 | FA4521970004 | SAR Tape Formatting |
| 10 | FA4521960008 | VLV Focal Length Not Fixed |
| 11 | FA4521960009 | S/C Switch on KS-87Es Difficult to Access |
| 12 | FA4521960011 | Video Control Panel Location Interferes With Mission Tasks |
| 13 | FA4521960012 | Excessive Wear on KS-87E Film Magazine Cassettes |
| 14 | FA4521960013 | Default Focal Length Error for Oblique KS-87Es |
| Enhancement | | |
| 1 | FA4521960018 | Media Storage Rail Locking Pins Difficult to Insert |
| 2 | FA4521960019 | DARMS Does Not Have Hot Key Access to Sensor Configuration Window |
| 3 | FA4521960020 | DARMS Magazine Inventory Difficult to Update |
| 4 | FA4521960021 | Excessive Airflow Noise at High Heat Settings |
| 5 | FA4521970005 | APU Battery Access |
| 6 | FA4521970006 | Flight-Following Station Needs a True Airspeed Indicator |
| 7 | FA4521970007 | Navigator CARA Display Position |
| 8 | FA4521970008 | DARMS Keyboard |
| **NOTE:** The definitions of deficiency and enhancement are as stated in TO 00-350-54. | | |

## 2.4 OVERALL ASSESSMENT.

**2.4.1** Questionnaire responses and debriefing comments from crew members indicated a high degree of satisfaction with the upgrade. Crew member compliments were noteworthy for the following areas.

**2.4.1.1** The MC station was praised as a well-designed area which will provide outstanding support to OSIA and the Open Skies mission. The area facilitates flight following and has excellent radio capability.

**2.4.1.2** The DARMS was cited as a vast improvement over the Miletus system on the IOC aircraft. The DARMS provides heightened SA which is critical to mission accomplishment.

**2.4.1.3** The CARA was singled out as an improvement over the radio altimeter on the IOC aircraft. The LED readout was noted as having special utility.

**2.4.1.4** The locations of 115-VAC power outlets were mentioned as an excellent design feature providing convenient power to operate carry-on equipment critical to mission accomplishment.

**2.4.2** In addition to questionnaire responses, sortie debriefing discussions revealed the crew members felt the modification was on track and would deliver a system they could use with pride worldwide.

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## SECTION 3 - CONCLUSIONS AND RECOMMENDATIONS

### 3.1 CONCLUSIONS.

**3.1.1 Overall.** The Phase II upgrade of the Open Skies OC-135B is satisfying user needs; however, the identified deficiencies must be corrected to enable the Phase II upgrade to fully support the Open Skies observation mission.

**3.1.2 By Objective.**

**3.1.2.1** The capability of the internal APU to provide cabin heating, electrical power, and engine starting without the aid of external support equipment fully supports the OC-135B ground operations.

**3.1.2.2** The KS-87 and the KA-91 accommodate optical filter changes; however, the KS-87 must be improved to fully accommodate resetting the s/c switch.

**3.1.2.3** The capability of the CARA to be operated by the pilot, copilot, navigator, and DMC supports completion of their mission tasks; however, the altitude error must be corrected.

**3.1.2.4** The capability of displays available at the flight-following station must be improved to fully support completion of DMC and FM mission tasks.

**3.1.2.5** The capability of the sensor suite to be operated from the SO station must be improved to fully support completion of LSO mission tasks.

**3.1.2.6** The capability of displays available at the MC station supports completion of MC and other observer mission tasks; however, inaccurate presentation of KS-87 and KA-91 operating status and the DARMS altitude error must be corrected.

**3.1.2.7** The capability of the onboard media storage and temperature-conditioning equipment fully supports the OC-135B mission.

**3.1.2.8** Media processing by the OSMPF meets user requirements.

**3.1.2.9** The RMA of sensor suite and the internal APU must be improved to fully support Open Skies observation mission requirements.

## 3.2 RECOMMENDATIONS.

**3.2.1** Expeditiously correct the deficiencies identified by DRs FA4521960001 through FA4521960004, FA4521960007 through FA4521960009, FA4521960011 through FA4521960013, and FA4521970001 through FA4521970004 (OPR: HQ ACC/DRRR; OCR: HQ ACC/DOYR).

**3.2.2** Implement the enhancements identified by DRs FA4521960018 through FA4521960021 and FA4521970005 through FA4521970008 in the most timely and cost-effective manner practical (OPR: HQ ACC/DRRR; OCR: HQ ACC/DOYR).

**3.2.3** Provide necessary training to technicians responsible for maintaining the SAR and the APU (OPR: HQ ACC/LGM).

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